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FINAL REPORT

PROJECT T1176

INSTRUMENTATION OF A DRAINAGE DEMONSTRATION SITE ON A COMPACT BASAL TILL SOIL

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March 31, 1989

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SUMMARY

The Atlantic Land Improvement Contractors Association (ALICA) sponsored a subsurface drainage Demo Day in Cornhill, New Brunswick, August 20, 1988, which resulted in the installation of a replicated (x4), on-farm, field scale subsurface drainage system on a shallow, compact basal till soil (Farm Focus, Sept. 14, 1988). Approximately 6000 m of subdrains were installed creating four independent plots of equal size, complete with separate outlets, buffer drains, and heated data collection shelter (to provide year round access to the outlets). The value of the resultant drainage facility was $24 000; in addition, ALICA procurred a ten-year lease with the site owner for access rights to the site for data collection purposes.

Later that year ALICA, in co-operation with the Research Branch of Agriculture Canada, Fredericton, and the NB Department of Agriculture, submitted a project proposal ($36 200) to the Canada - New Brunswick - Agri Food Development Agreement (1984-1989) to instrument the Demo Day facility for assessment of drainage performance. The proposed funding, together with additional equipment contributed by the co-operators ($15 000) would permit long-term, automatic acquisition of concurrent drain outflow, water table fluctuation, and water quality data. Project T1176 - Instrumentation of a Drainage Demonstration Site on a Compact Basal Till Soil - was subsequently approved on December 2, 1988.

This report summarizes the function of the equipment purchased and associated installation activities and describes the type of information that will be generated from the instrumented Demo Day drainage facility in subsequent years.

a)

b)

Figure 1. The Cornhill Valley, site of the ALICA Drainage Demo Day: a) early preparations for the Demo Day; b) men and machines ready to work.

SITE AND DRAINAGE SYSTEM DESCRIPTION

The eight ha site is located in Cornhill (Kings County), an active dairy farming area of southern New Brunswick (Figure 1). The soil was recently identified as a Petitcodiac soil map unit. Soils within this map unit are typical lodgement tills; they are compact at shallow depth and exhibit impeded vertical water movement; surface textures vary from silt loam to gravelly clay loam (MacMillan and Chalifom, 1980. Land base study of Havelock Parish. NB Dept. of Agriculture).

Figure 2 shows that the drainage system is comprised of a random section (centre), and four independent subsystems each of identical area, drain spacing, and number of laterals (1.1 ha, 12 m, and 13, respectively). Each of the four subsystems connect to non-perforated collector drains that lead to individual outlets. Buffer drains that connect to an additional separate outlet isolate the plots from water from outside sources.

DATA COLLECTION SHELTER

To facilitate year round measurement of drain flow rate from the four individual subsystems described above, a data collection shelter was built over the four drainage outlets (Figure 3). Ample insulation and a propane heating system was required inside the shelter to permit measurements during the winter months when, although outside temperatures are normally below freezing, drain flow events can occur due to upward groundwater seepage or temporary thaw conditions.

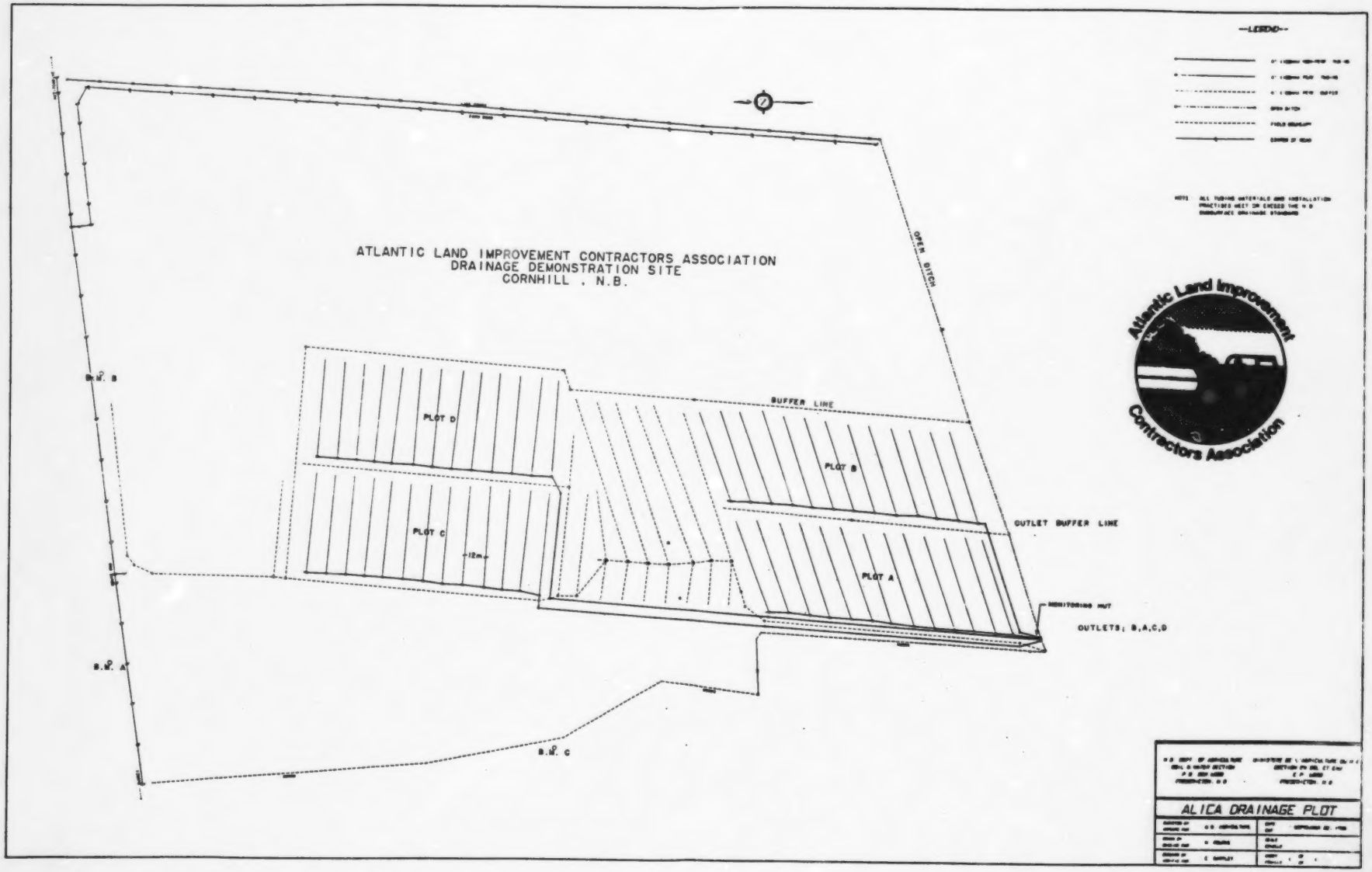
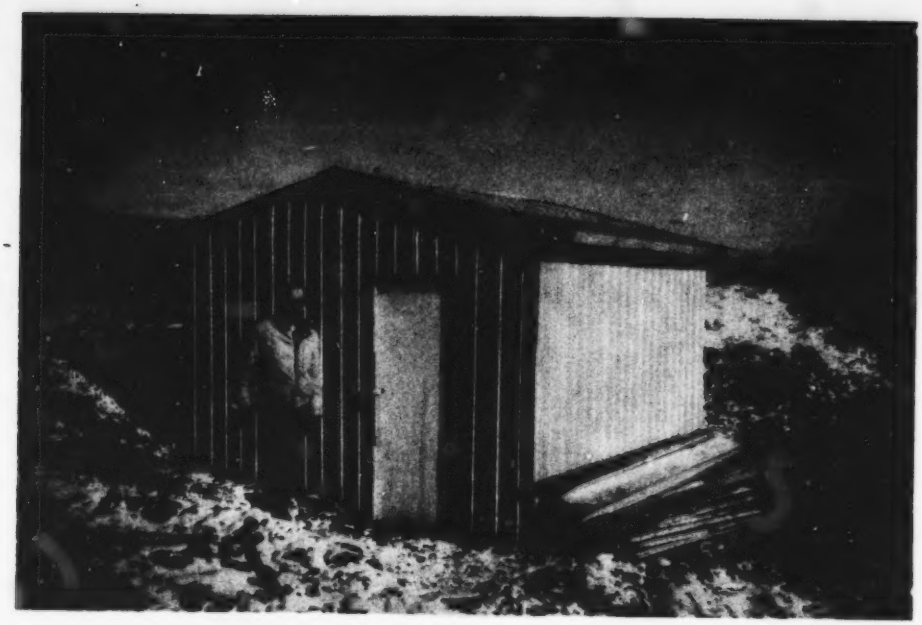
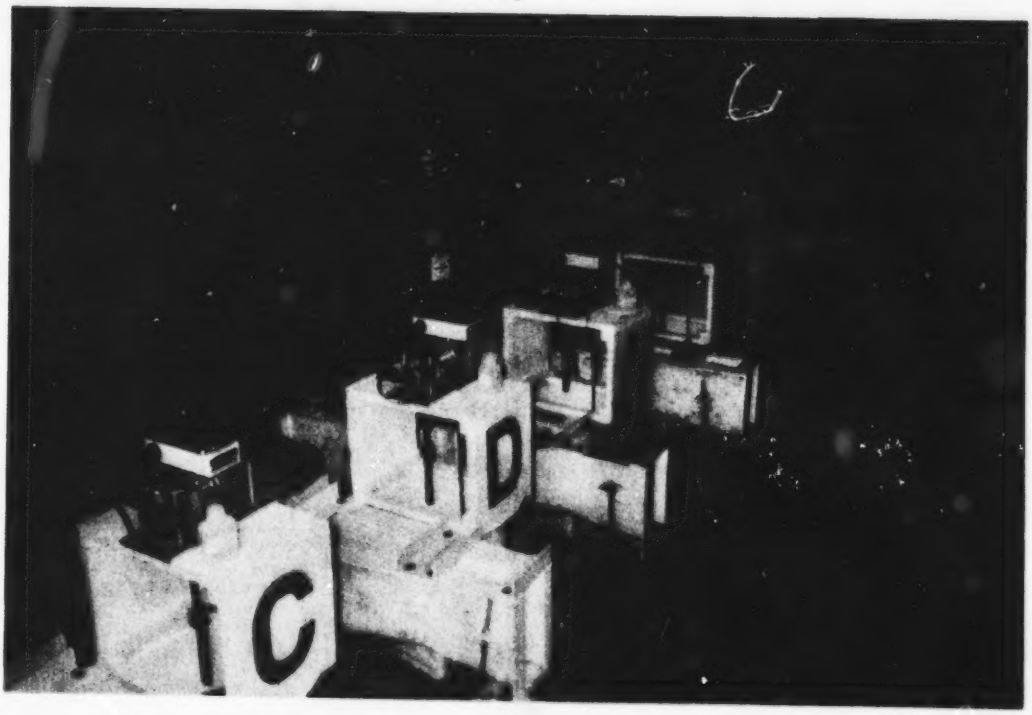


Figure 2. Subsurface drainage plan for the Drainage Demo Day. Separate outlets for plots A, B, C, and D are located to the southwest corner of the site.



a)



b)

Figure 3. a) Heated data collection shelter which houses the drainage outlets for plots A, B, C, and D; b) inside view showing some of the monitoring equipment. Note the gravel floor which evacuates drainage water from the building; heating system is to the right.

Drainage water exits the shelter through a coarse gravel floor (0.6 m thickness) that connects to an adjacent stream (Figure 3b).

The shelter structure was supplied by ALICA; project funds were used for insulation, the heating system and installation of the shelter over the outlets.

MONITORING EQUIPMENT

The following equipment was purchased through Project T1176 or provided by the project co-operators to permit concurrent acquisition of drain outflow, water table fluctuation, and water quality data.

1. Parshall Flumes

These fibreglass, prefabricated devices by Plasti-Fab, Inc. of Tualatin, Oregon* determine the drain flow rate from each drain outlet (Figure 4). They are constructed so that a given height (or head) of water passing through the flume corresponds to a known flow rate. The specific model installed at the Demo Site (1" throat) has a peak discharge capacity of 7 L/S at 0.22 m head. To obtain a continuous record of drain flow rate, stage recorders that monitor the changing level of water passing through the flume are required.

2. Stage Recorders

To facilitate continuous recording, as mentioned in (1) above, the Parshall Flumes were equipped with Omnidata WLI Data Pods (Omnidata, Inc., Salt Lake, Utah)*. These are potentiometer-float-pulley systems that record and store water levels every six minutes to one hour with a resolution of ± 3 mm (Figure 5).

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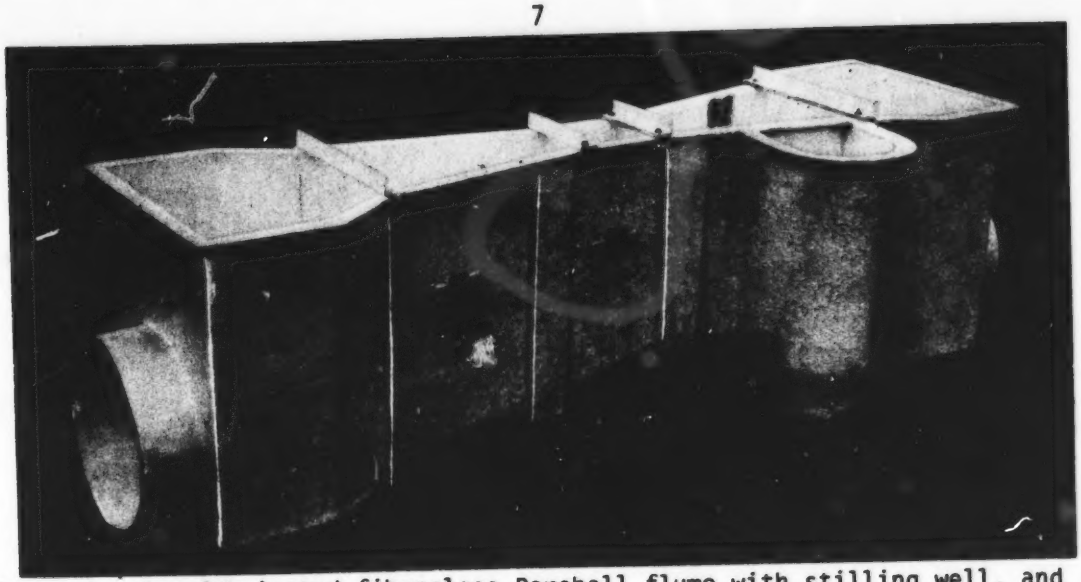

Figure 4. Pre-fabricated fibreglass Parshall flume with stilling well, and end adapter for installation to a drain line.

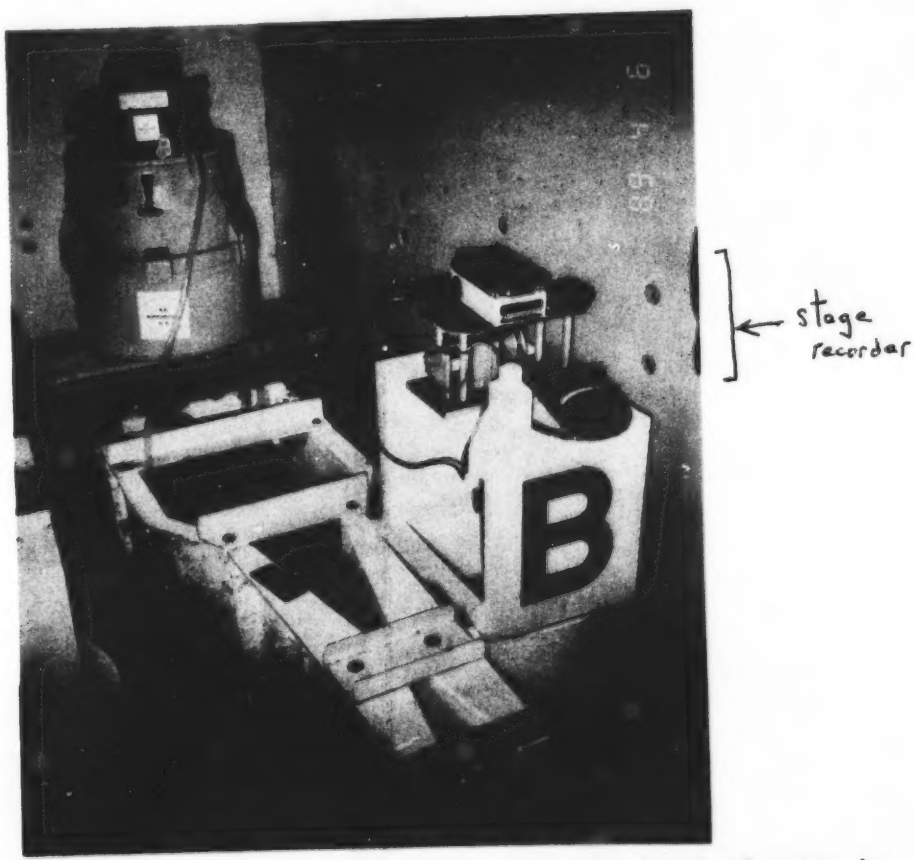

Figure 5. Stage recorder, which measures and records the level of water in the observation well. The level of water in the well corresponds to a known discharge rate through the flume.

3. Water Samplers

Analysis of water samples from subsurface drainage systems provides information on movement of fertilizer and pesticides out of the crop root zone. The ISCO Wastewater Samplers (Lincoln, Nebraska) shown in Figure 6 permit unattended collection of up to twenty-four separate water samples at predetermined time intervals and sample volumes. When full, the sampler automatically shuts off; for continuous operation, the sampler base containing the full set of sample bottles may be removed and replaced with a second base containing empty bottles.

4. Pressure Transducers

Pressure transducers can be used to detect the height of water in an observation well, similar to the float-pulley system of (2), but are more portable, rugged, and do not require as much protection from the elements (i.e. wind, rain, sleet). The particular model purchased, Druck PDCR 930/Ti (Danbury, Connecticut)*, has a full scale recording range of 1.75 m (2.5 psi) and an accuracy of approximately ± 5 mm. Four of these devices (Figure 7) will be installed in shallow observation wells within each drainage subsystem to measure water table fluctuations caused by the action of the drains. Several transducers are connected to a single "data logger", which powers the transducers and stores the measured water table information.

5. Data Loggers

Portable, lightweight, multi-channel, battery operated data loggers by Omnidata (Logan, Utah)* were selected to power and store data from the

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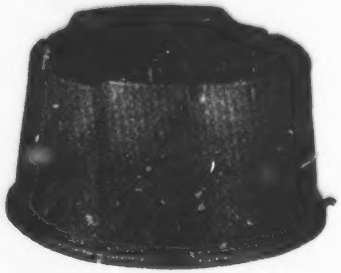
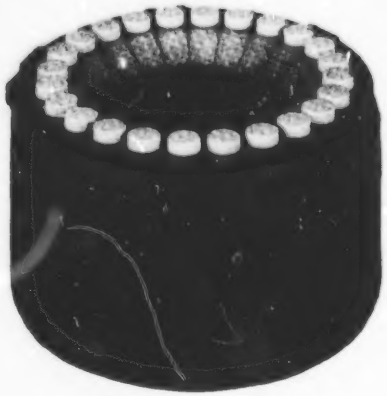
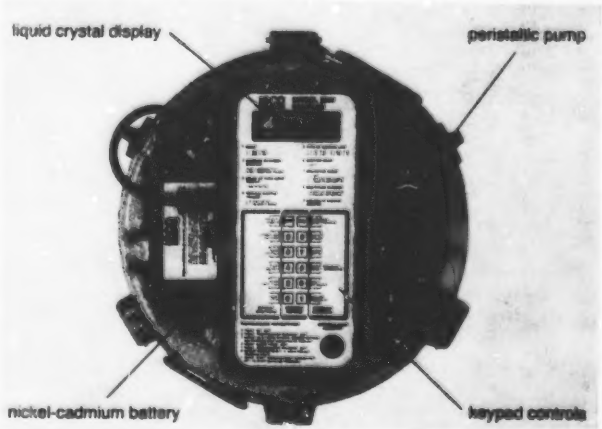






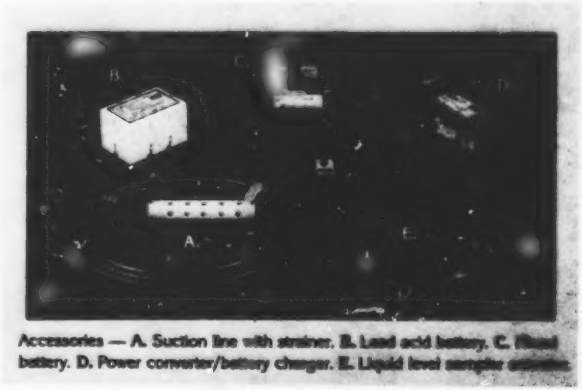
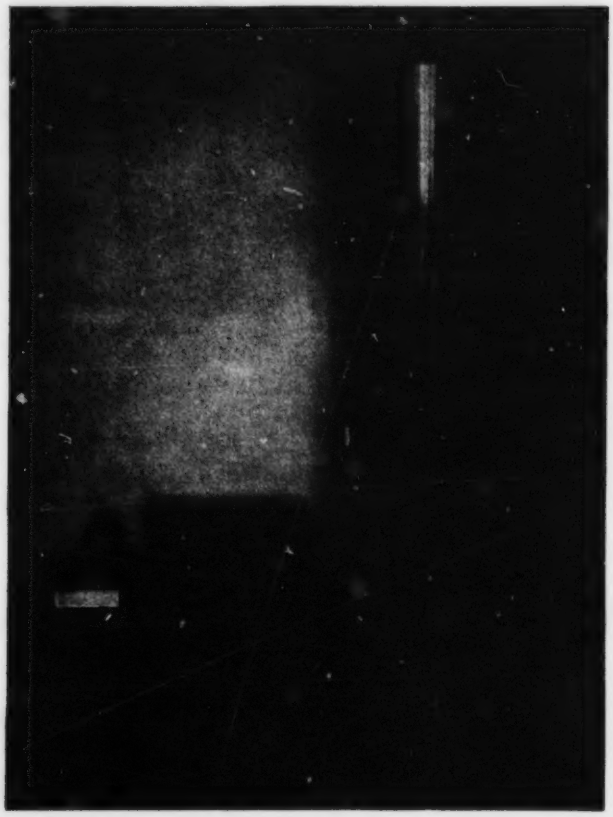

Accessories — A. Suction line with strainer. B. Lead acid battery. C.
battery. D. Power converter/battery charger. E. Liquid level

Figure 6. Sequential wastewater sampler; programmable; user defined sampling interval and sample volume.



a)

b)

Figure 7. a) Pressure transducer (immersed in colored water for demonstration purposes) to detect water table level; and b) data logger that powers the transducers and stores the measured water table levels.

pressure transducers (Figure 7). These devices are user-friendly and can operate unattended for several weeks, depending on the number of sensors attached (maximum 12 channels), the excitation time required by the sensors, and the logging interval. A variety of sensors, in addition to pressure transducers, are compatible with the data loggers.

FUTURE ACTIVITIES AT THE DEMO SITE

With the Drainage Demo Site equipped as described in the preceding section, the following studies may be pursued:

1. Determination of annual drain flow hydrograph for a known drainage system depth and spacing on a Petitcodiac soil.
2. Contribution of winter/spring thaw events to the annual drain flow hydrograph.
3. Upon completion of (1) and (2) above, determination of the effects of deep tillage on annual drain flow.
4. Determination of drain flow-hydraulic head relationships for a Petitcodiac soil.
5. Changes in drainage system performance over several years (that is, changes in water table recession and drain outflow rates).
6. Determination of the quality of the drain discharge over time, as the site is brought into intensive agriculture and is subsequently managed through several rotations and cultural practices (for example: manure, chemical fertilizer, and pesticide applications; alfalfa, corn production; subsoiling).

In addition, the monitored facility is an ideal demonstration site for farmers, contractors, extension staff, and related professions.

The data collection shelter is currently operational with flumes, water samplers, and stage recorders. Water table observation wells (with pressure transducers) will be installed after the site is seeded in 1989.

Agriculture Canada and NB Department of Agriculture co-operators began collecting drain discharge data in February 1989.

SUMMARY OF PROJECT EXPENSES

1.	Pressure transducers (16)	$15,642.75
2.	Automatic water samplers (2), with accessories	7,217.56
3.	Data loggers (2), with multiplexers and storage packs	8,681.50
4.	Parshall flumes (1)	938.36
5.	Building insulation, installation, heating system	3,570.38
	Total	$36,050.55

AGRICULTURAL DRAINAGE DEMONSTRATION DAY

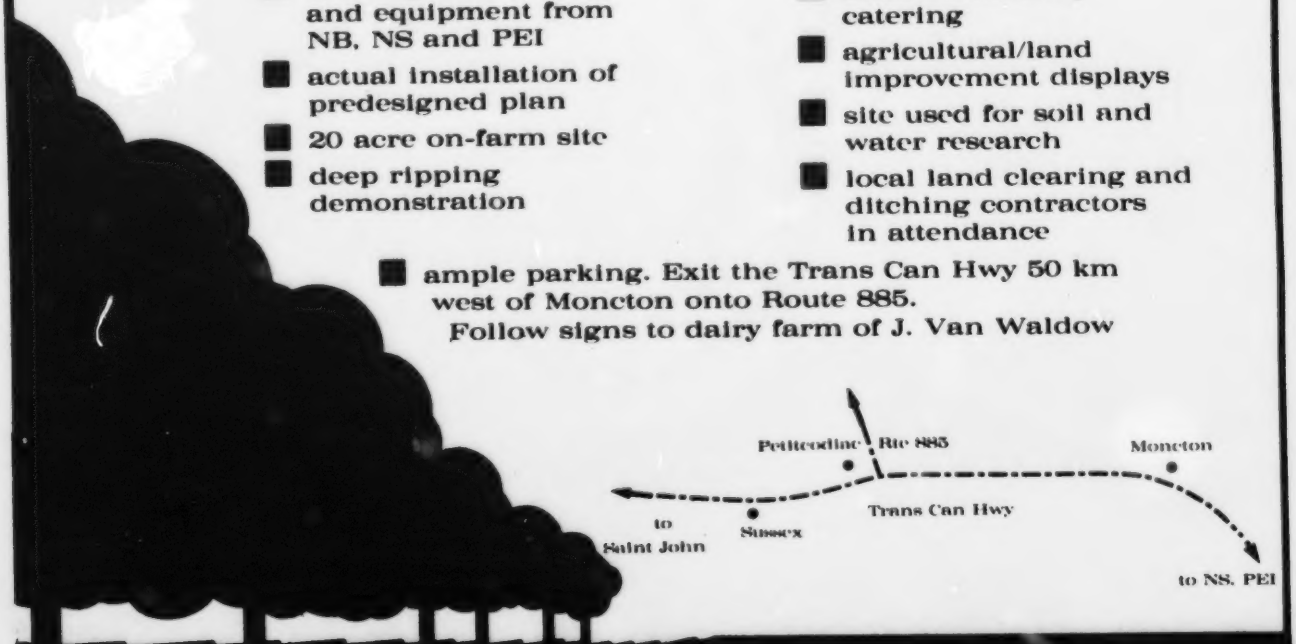
FOR FARMERS AND LANDOWNERS
Cornhill,
New Brunswick

SATURDAY, AUGUST 20, 1988
10 am – 4 pm
(rain date August 22)

A FIRST IN ATLANTIC CANADA!

- drainage contractors and equipment from NB, NS and PEI
- actual installation of predesigned plan
- 20 acre on-farm site
- deep ripping demonstration
- local community catering
- agricultural/land improvement displays
- site used for soil and water research
- local land clearing and ditching contractors in attendance

- ample parking. Exit the Trans Can Hwy 50 km west of Moncton onto Route 885. Follow signs to dairy farm of J. Van Waldow



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